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ABSTRACT

The Sampling Organization and Recall Through Strategies (SORTS) test was administered to 87 educable mentally retarded (EMR) children (mean chronological age, 97 months; mean IQ, 70) and 31 nonretarded (NR) second grade children to determine Ss' characteristic grouping responses, the effects of various organizational strategies on recall and mnemonic organization, and the implications of the organizational strategies approach for classroom instruction. Ss' sorting responses were coded according to the following categories: syncretic strategies (level one), perceptual strategies (level two), low associative strategies (level three), and superordinate and categorical strategies (level four). In the third sort of the SORTS test, 13% of the EMR Ss sorted the items into groupings classified as associative or better. By contrast, 55% of the nonretarded sample produced groupings at the same level. Recall scores of the two groups showed the NR sample to have remembered an average of nearly four items more than the EMR sample. EMR children who had grouped associatively showed significant correlations between recall and clustering. A similar significant correlation was not observed for the NR sample. Training activities designed to teach children to seek better relations among stimuli in learning tasks were recommended. (GW)

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A COMPARISON OF CONCEPTUAL STRATEGIES FOR GROUPING AND REMEMBERING EMPLOYED BY EDUCABLE MENTALLY RETARDED AND NON-RETARDED CHILDREN[1]

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February 1973

Department of Health, Education and Welfare

U. S. Office of Education

Bureau of Education for the Handicapped

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The research reported herein was performed pursuant to a grant from the Bureau of Education for the Handicapped, U.S. Office of Education, Department of Health, Education, and Welfare to the Center for Research, Development and Demonstration in Education of Handicapped Children, Department of Special Education, University of Minnesota. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education and Welfare
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RESEARCH AND DEVELOPMENT CENTER
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The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

A Comparison of Conceptual Strategies for Grouping and Remembering Employed by Educable Mentally Retarded and Non-retarded Children[1]

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Many writers have noted differences in the learning strategies generated by retarded learners as opposed to "normal" learners (Iano, 1971; Prehm, 1968; Sigel, 1972). In particular, Riegel, Danner and Taylor (1972) have assumed that such differences exist with respect to grouping and classification strategies, and have developed training procedures intended to reduce the difficulties encountered by educable mentally retarded (EMR) children. A test (the Sampling Organization and Recall Through Strategies, or SORTS test; Riegel, 1972a)has been developed to assess the generation of groupings and the understanding of categorized groups of items, and to measure the effects of such groupings on recall and clustering in young children. However, this test has previously been administered only to educationally handicapped children. The present paper reports the findings of a study in which EMR and non-retarded children were compared in their performance on the SORTS test.

Differences between educationally handicapped children and their "normal" chronological agemates have typically been investigated using variables related to quantitative performance (e.g., number of questions correctly answered) or rate of learning (e.g., number of trials to criterion). In this study our purpose was to

explore strategies employed by EMR and non-retarded children in a test of grouping performance, recall, and the relationship between the two. Qualitative data have been collected in order to specify the kinds of differences which exist between the populations on measures of organization of input (sorting), as well as quantitative data regarding the effects of input strategies on recall.

It should be noted that we are aware of the traditional problems in comparative studies with EMR and non-retarded (NR) subjects (e.g., Baumeister, 1967). Our purpose here is not simply to add to the already voluminous literature demonstrating that NR children peform better than EMR children. Rather, it is our purpose to identify a specific area of difference (i.e., in grouping and related organizing skills) with the dual aim of validating in part the discriminatory capacity of the SORTS test, and of providing a basis for the development of effective intervention procedures for use in teaching educationally handicapped children more effective learning strategies.

For this study our chief concern was organizational strategies, and, in particular, how things are classified or categorized. Bruner, Goodnow and Austin (1956), in discussing categories, provide a perspective which we have adopted in the present study. Basically, it is their position that categorization is the rendering of discriminably different things equivalent; that is, the child learns to respond to things in terms of group membership rather than in terms of their uniqueness. The study of equivalence then becomes the study of coding and recoding processes employed by the individual. In

this sense, the characteristic form of coding employed by subjects becomes "a dependent variable worthy of study in its own right" (Bruner, et.a., 1956, p. 8).

A number of studies have noted different characteristic forms of coding at different age levels in normal children. For example, Bruner and Olver (1963) found that first graders gave proportionately fewer superordinate responses when comparing items than fourth graders. Lippman (1971) found similar age trends when he compared kindergarteners, second graders, fourth graders and college students on their responses in a word association task. The younger children gave significantly more perceptually-based responses to noun associations while the older subjects produced more categorical and function-based responses.

Such evidence for the development of increasingly superordinate responses to a set of stimuli appears to be fairly consistent with normal subjects. The retarded, however, have been found to be significantly less able, at older ages, to identify stimulus items within a context of superordinate structure (Stephens, 1964, 1966). The fact that they identified fewer instances of specified categories led Stephens to conclude that they had simpler categories than their non-retarded counterparts, and were thus less able to discover (or generate) relationships between new and old experiences.

In previous investigations using the SORTS test, Riegel (1972a) found that the majority of young (6-8 year old) EMR children tested either failed to utilize a grouping strategy at all, or tended to group items together on the basis of perceptual similarity (i.e.,

color). Few subjects utilized intrinsic attributes of the items in seeking superordinate relations. Informal pilot testing of several non-retarded children indicated that this may have pinpointed a specific difference in the learning strategies utilized by EMR children. However, the fact that EMR children tend to utilize fewer superordinate relations constitutes only one aspect of the process of learning from organized material.

As the use of organization for mnemonic mediation develops, changes are observed in organizational indices at both input (sorting and the identification of associative relations) and output (clustering of recall). The number of items recalled in a variety of situations has been consistently related to age differences (e.g., Nelson, 1969; Vaughan, 1968). Analogous to the development of higher forms of associative grouping, and concomitant with increases in overall recall, has been the observation that with age the child increasingly tends to cluster his recall (Bousfield, Esterson and Whitmarsh, 1958; Nelson, 1969; Rossi & Rossi, 1965; Vaughan, 1968). Equally high levels of clustering by retarded children, however, have not been observed (Osborn, 1960; Rossi, 1964). The fact that retarded subjects were not found to cluster to the extent that non-retarded subjects did suggested in these studies that the retarded subjects were in fact manifesting inefficient learning habits.

The present study is an extension of earlier investigations of the learning habits of young children. While the SORTS test was developed with the learning characteristics of EMR children in mind,

it has not been administered systematically to a group of average non-retarded children. In this study comparisons between EMR and non-retarded children were made in order to further explore the characteristic grouping responses of each group, their effects on recall and mnemonic organization, and the implications of the organizational strategies approach for classroom implementation.

Method

Subjects. 87 EMR children with a mean C.A. of 97 months and mean I.Q. of 70 were selected from pre-primary special classes in the St. Paul, Minnesota public schools[3] for pretesting in preparation for a study conducted in the Spring of 1972 (Riegel, 1972b). In addition, 31 non-retarded second-grade children were drawn from four schools in the same district representing a similar range of demographic composition to the schools contributing EMR subjects. The mean C.A. for this sample was 97.1 months. Although I.Q. scores were not available for the non-retarded subjects, the children were selected by the principals and teachers in each school on the basis of their showing "average" ability in a regular second-grade class. Thus, children at either extreme in their regular classes were excluded from the NR sample.

Procedure. The SORTS test represents a combination of methodological techniques (i.e., sorting, interview, recall and clustering analyses) utilized in a number of previous studies of organizational processes in children. Use of this test yields three basic scores for each subject: one based on the groups he forms by sorting an array of

20 items, and his reasons for those groupings; one based on his recall of those items following the sorting procedure; and a clustering score based on the degree to which the output (recall) order corresponds to the input (sorting) organization of the subject. Although a detailed description of these three scores can be found in Riegel (1972b) a summary of the four levels of grouping types used for coding the child's sorting responses is presented here for the reader's information:

Level 1: Syncretic strategies. Grouping at this level reflects a general failure to generate relations between items on the basis of an attribute or set of attributes. Grouping items by their spatial contiguity ("because they were next to each other") or subordinating the sorting task to an unrelated manipulative operation ("I wanted to make a square with the pictures") are examples of this level. Also included are instances of no strategy for grouping at all, such as the case of a subject simply pulling all items into a single pile or not moving them at all.

Level 2: Perceptual strategies. Groupings at this level were suggested by the results of Riegel's (1972a) studies, in which a sizeable proportion of EMR subjects (approximately 30%) sorted items on the basis of characteristics of attributes related to color, shape or size. When color, for example, was introduced as an irrelevant attribute of the stimulus materials, younger children tended to sort items on that basis, rather than attending to more intrinsic characteristics of the items such as function or category membership (cf. Birch & Bortner, 1966; McGurk, 1972).

Level 3: Low Associative strategies. This level includes associations for which intrinsic or semantic attributes of the items constitute the basis for grouping. Such groups as thematic collections (formed by creating a story about the items) and complexes (collections of items for which interitem associations are formed, but for which no over-all defining attribute is available) are examples of level three strategies.

Level 4: Superordinate and categorical strategies. Groupings at this level include superordinate groupings in which all items in a group are subsumed under a single intrinsic attribute or attribute set. Examples of groupings at this level include groups based on items having similar function (e.g., they all are for eating; you can live in them) or on category membership (e.g., they are furniture).

Each child was individually administered the SORTS test in a separate room. The first two tasks, in which the subjects were asked to sort an array of 12 animal pictures (3 1/2" x 3 1/2") into piles "that are alike," were treated as warm-up trials for the third sort. Sort 3 consisted of an array of 20 pictures of concrete inanimate objects which were to be sorted and recalled by the subjects. After naming each picture in this array to insure familiarity, the subjects were instructed as follows:

> Put the pictures together in piles so you can remember them. After you finish putting them together I will cover them up and see if you can remember them. Now put them together the way you think is best.

When the subject had finished sorting the pictures, they were covered, and he was asked to tell the names of as many pictures as he could remember. Following recall, the pictures were uncovered and the subjects' reasons for each group he had formed were recorded. A more detailed description of this procedure is reported by Riegel (1972a).

Results

Sorting level. In sort 3 of the SORTS test, 13% of the EMR sample sorted the items into groupings classified as associative or better (level 3 and level 4 combined). By contrast, 55% of the non-retarded sample produced groupings at this level. Table 1 presents the number of subjects in each sample producing groupings at each of the four levels defined above, as well as the percentage of subjects represented at each level. As noted above, the combination of levels 3 and 4 produced dramatically different proportions for the two groups,

which were highly significant ($z = 4.705$, $p < .001$) as measured by a proportion test (Bruning and Kintz, 1968). In addition, a comparison of the proportion of subjects in each sample producing superordinate groupings (level 4 only) was made. The difference between the 7% of the EMR subjects and 26% of the non-retarded subjects (see Table 1) was also found to be significant ($z = 2.772$, $p < .01$).

Recall. Comparison between the two groups on recall scores showed the NR sample to have remembered an average of nearly four items more than the EMR sample. Table 2 presents the means and standard deviations for these data. As expected, the two groups differed significantly on this measure ($t = 6.113$; $p < .001$).

Clustering. An index of clustering (Frankel and Cole, 1971) was calculated for the recall of each subject, yielding a Z score. A score greater than 1.96 was taken as indicating clustering beyond chance. Table 3 presents the frequency of significant clustering by groups. As may be seen, the trend of the results favors the NR sample, with 16% of the NR subjects clustering as compared with 7% of the EMR sample. This difference, however, was not significant ($Z = 1.50$, $p < .10$).

Correlational analyses. Correlations between recall and clustering were calculated for each of the samples. Positive correlations between these variables for both groups were found. Although there appeared to be a greater relationship between these variables for

Table 1. Frequency and percentage of subjects at each level of grouping.

	EMR	NR
Level 1	32 (37%)	4 (13%)
Level 2	43 (50%)	10 (32%)
Level 3	5 (6%)	9 (29%)
Level 4	6 (7%)	8 (26%)
Level 3 and 4 combined	11 (13%)	17 (55%)

Table 2. Means and standard deviations for recall data.

	EMR	NR
Mean	5.65	9.55
s.d.	2.98	3.12
N	86	31

Table 3. Frequency of clustering by group.

	EMR	NR
No clustering	N = 80 (93%)	N = 25 (84%)
Clustering	N = 6 (7%)	N = 5 (16%)

the EMR sample ($r = .51$, as compared with $r = .23$ for the NR group), a test of the difference between these correlations (Bruning and Kintz, 1968) was not significant ($Z = 1.51$, $p < .10$).

Further analysis of the relationship between sorting and recall was made by blocking the subjects according to whether or not they sorted at levels 1 and 2 or at levels 3 and 4 (non-associatively versus associatively). A somewhat surprising correlational pattern was observed in this analysis. No significant correlations were found between recall and clustering for non-associative sorters (see Table 4). However, EMR children who had grouped associatively showed significant correlations between recall and clustering. Contrary to expectation, a similar significant correlation was not observed for the NR sample. Table 4 presents these data. The correlation between recall and clustering was significantly different for the two samples, with a greater relationship found for the EMR subjects ($Z = 2.155$, $p < .05$).

Further analysis of the recall data. The recall data was further analyzed to determine whether differences existed between the groups on either the number of their groupings they had accessed for recall, or on the mean number of items per grouping recalled. Table 5 presents these data. As may be seen in this table, the NR subjects accessed more of their groupings during recall ($t = 2.83$ [115 d.f.], $p < .01$). A comparison of the mean number of items per group recalled, however, did not reveal a difference between the two samples.

Table 4. Correlations of recall with clustering for associative and non-associative sorters.

EMR		NR	
non-associative sorting (N = 73)	associative sorting (N = 13)	non-associative sorting (N = 13)	associative sorting (N = 17)
.27	.77[a]	.22	.13[a]

Table 5. Number of groupings and items per grouping recalled.

	EMR N = 86	NR N = 31
Mean Number of groupings	3.036 (s.d. = 1.42)	3.966 (s.d. = 1.88)
Mean items per group	2.087 (s.d. = 1.21)	2.341 (s.d. = 1.26)

Repetitions and intrusions. Three types of errors were observed during recall which were compared between the samples to discover whether systematic differences existed. These errors were classified as: repetitions (naming the same item again during recall), categorical intrusions (items named during recall which were not among the items presented, but were conceptually related to one of the five embedded categories), or non-categorical intrusions (items not presented, and also unrelated categorically to the items in Sort 3).

Table 6 presents the number of subjects in each sample making each of the three types of errors. As may be seen in this table, there were no differences between the groups on either proportion of subjects repeating items or on proportion showing categorical intrusions.

A difference was found, however, in the number of subjects producing non-categorical intrusions. Whereas 13% of the NR subjects recalled conceptually unrelated items, 40% of the EMR subjects did so. This difference was found to be significant ($Z = 2.734$, $p < .005$). A count of the specific items revealed that the majority (over 80%) of the items considered non-categorical intrusions were the names of animals presented in the earlier (warm-up) sorting activities of the SORTS test. Such a finding suggests that the EMR subjects may have had greater difficulty identifying the discrete phases of the SORTS test during its administration.

Table 6. Frequency and percentage of error types in recall protocols.

	EMR	NR
Repetitions (a)	N = 32 (37%)	N = 10 (32%)
Categorical intrusions (b)	N = 7 (8%)	N = 3 (10%)
Non-categorical intrusions (c)	N = 34 (40%)	N = 4 (13%)

Summary of Results

Non-retarded subjects were found to generate proportionally more associative groupings than EMR subjects. The majority of the EMR subjects either failed to generate a useful grouping strategy, or sorted solely on the basis of color. In addition, the NR subjects recalled significantly more items from the groupings they had formed, and tended to cluster somewhat more frequently during recall.

On the average, significantly more groupings were accessed by the NR sample during recall than were by the EMR sample. No differences were found in the mean number of items per grouping recalled. Correlations between recall and clustering proved somewhat surprising in that a greater relationship between these indices was found for the EMR sample than for the NR sample. This was particularly true for those subjects who had generated associative groupings.

Analysis of errors during recall revealed no differences in number of items repeated, and no differences in number of children producing categorical intrusions. However, a significant difference was found in the number of non-categorically related intrusions with the EMR sample recalling more items from the warm-up list.

Discussion

The results of this study confirm a number of previous findings related to the grouping and recall performance of young children. In particular, previous comparisons between EMR and NR subjects

have likened the performance of EMR subjects to that of a younger group of NR children. The data presented here support the analogy to a degree, and extend it. Whereas previous studies using recall as a dependent measure have on occasion failed to show differences between EMR and NR subjects (e.g., Osborn, 1960; Rossi, 1964; cf. Spitz, 1972), a large difference was observed in this study. Conversely, differences between the two populations have often been noted in the extent to which clustering of recall occurs. In this study, a trend toward proportionally more NR subjects clustering was seen, but this difference was not significant. Although these results appear at first glance to be discrepant with previous findings, the nature of the task administered precludes such a conclusion.

The fact that both recall and clustering scores were based on what the child did with the group of pictures during the sorting phase presents several difficulties in interpretation. It was our hypothesis that the more "associative" the relations generated by subjects, the greater their recall would be, due primarily to the availability of the information stored for retrieval. This relationship between storage and retrival, however, does not appear to be as straightforward as had been expected. Although proportionally more NR subjects sorted associately and their mean recall was higher, expected differences in the relationship between the two (as reflected in their clustering scores) were not obtained. An alternative interpretation, that other (uncontrolled) memory-related processes played an important role in increasing recall of the NR

subjects, appears somewhat more viable. It has been shown, for example, that spontaneous rehearsal strategies are generated more frequently with age (Keeney, Cannizo and Flavell, 1967) and that NR children use these strategies more than EMR children in short-term memory tasks (Belmont and Butterfield, 1971). It is possible that rehearsal was more frequently employed by the NR subjects during the sorting task, thereby contributing to their higher recall scores, but to a lesser extent to the observed clustering.

Additional support for this latter interpretation may be found in the difference observed between the samples on their correlations of recall with clustering. According to our expectations, the children in both samples who had sorted items into level 3 or 4 groupings should have shown significant correlations between recall and clustering. However, because the expected relationship was found only for the EMR sample, we may assume that some other process for recalling is being utilized by the non-retarded sample. While it is possible that the NR children were rehearsing the items in addition to (and apparently independent of) their sorting behavior, it might also be conjectured that the organization of this sample's recall was based on some other criterion. For example, whereas the NR child might sort items according to his own associative scheme, his recall might conform more to the imbedded categories within the test items, as influenced by the kind of recall processes noted by Bousfield (1953) in his category clustering analysis.

It seems that a further analysis of recall protocols might clarify this apparent paradox. In any event, we are led to suggest

a three-phase development of effective grouping-for-memory skills. The first phase comprises the development of relational abilities leading to the perception and generation of conceptual or associative groupings. The second phase comprises the application of these grouping abilities to a second end (i.e., remembering). The third phase involves the simultaneous use of a variety of storage and retrieval strategies which may transform and recode the information to be recalled several ways between input and output, and more fully reflect the flexibility of the normal child's effective processing abilities. While the associative sorters of the EMR sample appear to have been functioning in the second phase described above, the NR sample may well have been in the third; hence the unexpectedly low relationship between their recall and a clustering score which in the SORTS test is based solely on their sorting performance.

Implications

It has long been a tenet of the special educator that one must teach a child at a level appropriate to his current level of performance. Unfortunately, this has frequently been interpreted to mean that EMR children must have a great deal of perceptually enriched experiences and much repetition of content material if learning is to be achieved. An alternate view, more consistent with our own experience with such children, makes possible the identification of specific cognitive and conceptual difficulties in such a way as to facilitate the development of more appropriate

intervention techniques. The data collected in the present study provide such information. EMR children, for example, do not generally discover (much less, generate) associative relations between iters spontaneously, whereas a far greater percentage of non-retarded children matched on C.A. do so. Similarly, the recall of the NR children is significantly higher. Whereas it appears that the NR children were functioning at a level of mnemonic integration above that of the EMR children, it is also apparent that at least some of the latter were grouping items to good mnemonic effect. By far the majority of these EMR children, however, failed to generate associative level groupings.

There are indications that a three-phase developmental sequence of functional mnemonic activity exists. This is particularly evident when the task involves both input and output variables in conjunction. We would expect, if our conjecture is correct, that kindergarten children would resemble the EMR sample in that many would fail to generate associative groupings, that first grade children would show increased clustering according to their own sorting behavior, and that second grade children would replicate the findings of the present study. Further research is indicated with the SORTS test in order to investigate developmental differences in non-retarded children during the early school years. In addition, important information regarding the recognition and recall of categorized groupings obtained from this testing would further clarify the young child's ability to utilize information which is organized for him to good mnemonic effect. This line of research is currently under way, and is scheduled for completion by the authors in the Spring.

An additional implication of this line of research relates more directly to the classroom applications of research on children's processing skills. Fully 87% of the EMR sample did not generate functional associations for the items in the SORTS test. It would seem a logical procedure to develop training activities to increase the likelihood that such children will seek better relations between stimuli in the learning task. Initial steps toward the development of such activities have been taken (Riegel, Danner and Taylor, 1972). The results of the present study will be used in part to modify them. The sequence of activities has been presented to EMR children in their classes for a period of four weeks, at about 1/2 hour per day. The results of SORTS testing has shown that the frequency of both associative sorting and clustering during recall increases following training. In addition, comparisons between EMR children given this training and a like group not so trained have shown that when presented with categorically arranged items, the trained group was significantly better, both in identification of associative relations between the items, and in the maintenance of the category groupings during recall (clustering).

Although similar training has not yet been conducted using "normal" subjects, it is apparent that the "relative mental retardation" of the EMR subjects has been decreased, at least with respect to the effective use of grouping strategies. The continued application of such findings as those reported in this paper to the revision of the strategies training approach promises

to increase our understanding of effective techniques for improving the handicapped child's functional cognitive abilities.

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Footnotes

[1]Portions of this paper were presented at the annual meeting of the American Educational Research Association, New Orleans, March 1, 1973.

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